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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

SEPTEMBER 2014 SESSION

SUBJECT CODE	:	**FCD20203**
SUBJECT TITLE	:	**COOLING LOAD**
LEVEL	:	**DIPLOMA**
TIME / DURATION	:	**9.00 AM - 12.00 PM (3 HOURS)**
DATE	:	**07 JANUARY 2015**

INSTRUCTIONS TO CANDIDATES

1. **Please read the instructions given in the question paper CAREFULLY.**
2. **This question paper is printed on both sides of the paper.**
3. **Please write your answers on the answer booklet provided.**
4. **Answer should be written in blue or black ink except for sketching, graphic and illustration.**
5. **This question paper consists of TWO (2) sections. Section A and B. Answer all questions in Section A. For Section B, answer two (2) question only.**
6. **Answer all questions in English.**
7. **Fomula is appended.**
8. **Cooling Load Documentation is provided.**

THERE ARE 7 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

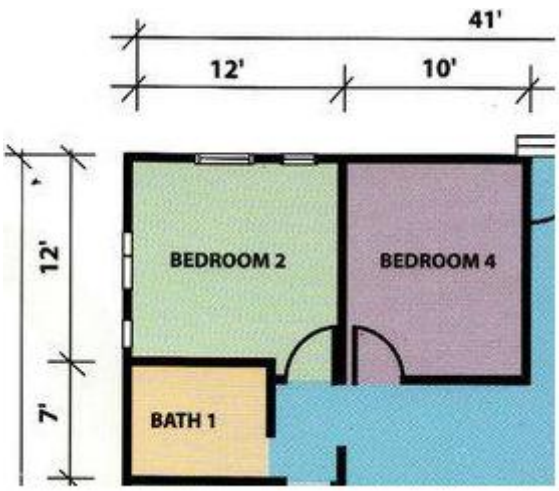

Figure Q1: Floor Plan

(a) Referring Figure Q1, employing the Cooling Load Check Figure, calculate the capacity of unit to be installed at Bedroom 4.

(5 marks)

(b) By using the answer in question 1(a) and the attached catalogue at Appendix 1, select the suitable unit to be installed at that area. Give at least two (2) reasons for your selection.

(15 marks)

Question 2

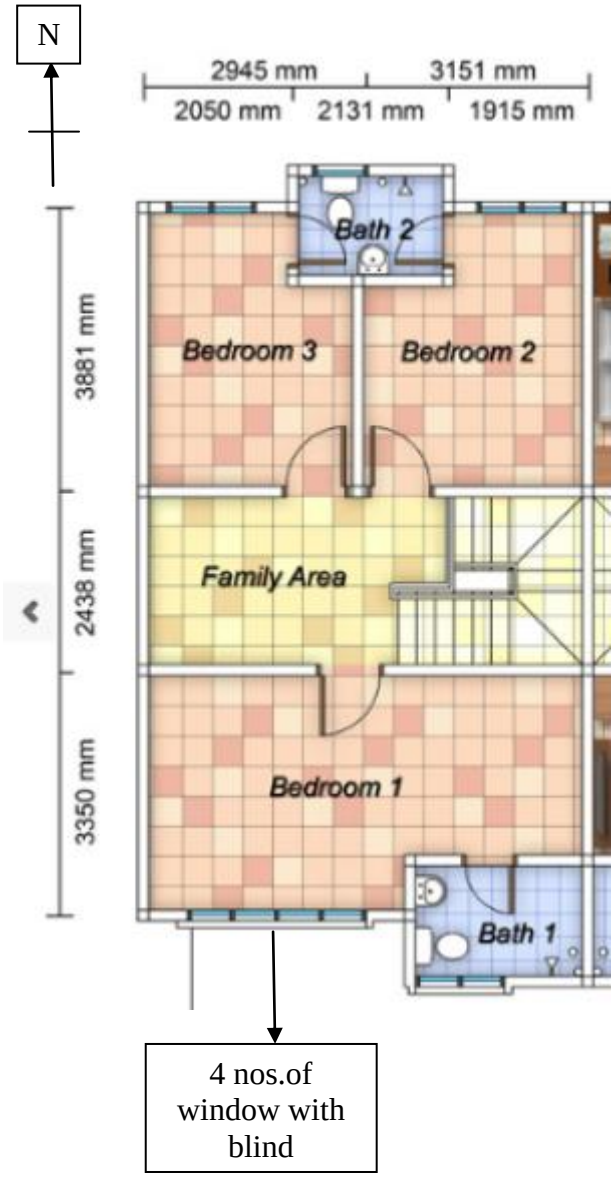

Figure Q2 (a): Double Storey Terrace House (Intermediate Unit) – First Floor

(a) Referring to the Figure Q2 (a), find the cooling load for Bedroom 1 employing the Daikin Method in Appendix 2.Its ceiling height is 3000mm. Please ignore bathroom 1.

Specification of construction:

a) Building : Double-Storey House
b) Outside wall : Medium construction (concrete block 150mm t)
c) Window glass : Normal (6mm t) with blind
d) Floor : Concrete with carpet place on the floor
e) Ceiling : Only concrete

f) Lights : Fluorescent lights (40w x 3units)

g) Persons : 2 (sitting on a chair)

h) Area : Standard temperature

i) Door : 1.2m x 2m

j)Window : 1m x 1.5m

Assume that, ground floor is already cooled.

(15 marks)

(b) By using the answer in Question 2(a) and the attached catalogue in Appendix 1, select the suitable unit to be installed at that area.

(5 marks)

Question 3

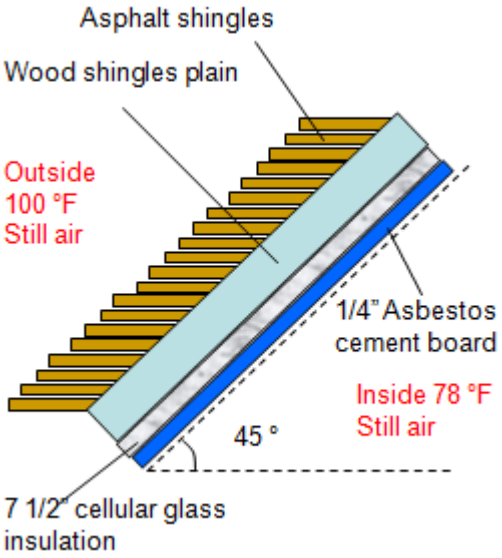

Figure Q3 (a): Heat Transfer in the Building

(a) Referring Figure Q3 (a), find the total thermal resistance in ft2.hr.F/Btu. Given that the surface emittance is 0.05.

(8 marks)

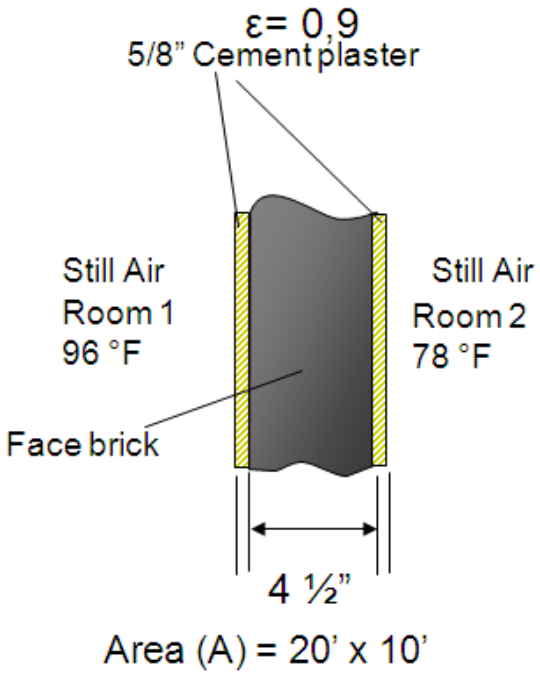

Figure Q3 (b): Heat Transfer thru Wall

(b) Referring to Figure Q3 (b), determine:

i. Total Thermal Resistance,∑R in ft2.hr.F/Btu

(7 marks)

ii. Overall heat transfer coefficient,U in Btu/ft2.hr.F

(2 marks)

iii. Heat Loss,q in Btu/hr

(3 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Answer only TWO questions.
Please use the answer booklet provided.

Question 4

(a) Calculate the local time (Tstd) corresponding to solar noon on 21 March in Bandar Baru Bangi.

(10 marks)

(b) Calculate the hourly instantaneous sensible load from the occupants in the conditioned space at 10 AM, 11 AM and 12 PM .Knowing that the building is designed for office use and houses for 58 occupants from 8 AM to 4 PM. For most occupied period, the occupants are expected to be seated and performing office work.

(10 marks)

Question 5

(a) Determine maximum angle of solar altitude, β on 21st March in Bandar Baru Bangi.

(10 marks)

(b) Find the hourly instantaneous sensible load of the conditioned space (occupied from 8 am to 4 pm) due to the office equipment at 10 AM, 1 PM and 2 PM. The heat gain from the office equipment is 5.0 w/ft^2.The floor areas for this space are 2800ft^2.

(10 marks)

Question 6

(a) Determine the total radiation for roof surface with 45º from vertical at Kota Kinabalu on 21st May facing South 30º East. Given that the value for angle of incidence, θ is 76.70º and direct normal radiation, G_{ND} is 280.56 Btu/hr.ft^2. You can neglect the Gr radiation.

(10 marks)

(b) Knowing that the heat gain from the office equipment is 6.5 W/ft^2 and the floor area for that space is 2750 ft^2.Determine the hourly instantaneous sensible load of the conditioned space which occupied from 8 am to 4 pm due to the office equipment at 9 AM, 2 PM and 3 PM.

(10 marks)

END OF QUESTION

Appendix 1 : Catalogue

Healthy Series Specifications

SPECIFICATIONS

MODEL	INDOOR UNIT			YWM 09G	YWM 10G	YWM 15G	YWM 20G		YWM 25G	
	OUTDOOR UNIT			YSL 09C	YSL 10C	YSL 15C	YSL 18C	YSL 20C	YSL 20C	YSL 25C
TYPE	ESSENTIAL			YWM09G (Ess)	YWM10G (Ess)	YWM15G (Ess)	YWM20G (Ess)	YWM20G (Ess)	YWM25G (Ess)	YWM25G (Ess)
	ION-AIR			YWM09G (ION)	YWM10G (ION)	YWM15G (ION)	YWM20G (ION)	YWM20G (ION)	YWM25G (ION)	YWM25G (ION)
TOTAL COOLING CAPACITY			Btu/h	9000	10000	13000	18000	19500	21000	24000
			W	2640	2930	3810	5275	5715	6155	7035
TOTAL POWER			W	880	877	1160	1747	2001	2020	2730
TOTAL CURRENT			A	3.88	3.7	5.09	7.73	8.9	8.92	13.18
POWER SOURCE			V/Ph/Hz	220 - 240 / 1 / 50						
INDOOR UNIT	AIR FLOW		cmm/cfm	7.79 / 275	8.78 / 310	9.77 / 345	14.44 / 510		18.41 / 650	
	DIMENSION	HEIGHT	mm	260	260		304			
		WIDTH	mm	799	899		1062			
		DEPTH	mm	198	198		222			
	WEIGHT		kg	10	12		16			
	CONTROLLER TYPE			LCD REMOTE CONTROLLER						
	CONDENSATE DRAIN SIZE		mm	16			20			
	AIR FILTER	Essential		SARANET						
		ION-AIR		SARANET + ANTI MICROBIAL + TITANIUM OXIDE						
	AIR TREATMENT	Essential		-						
		ION-AIR		NEGATIVE IONS						
OUTDOOR UNIT	AIR FLOW		cmm/cfm	18.4 / 650	24.4 / 860	27.5 / 970	34.0 / 1200	38.0 / 1340		42.5 / 1500
	DIMENSION	HEIGHT	mm	495	540		648			750
		WIDTH	mm	600	700		855			855
		DEPTH	mm	245	250		328			328
	WEIGHT		kg	28	32		57	59		62
	PIPE TYPE			FLARE						
	PIPE SIZE	LIQUID	mm/in	6.35 / 1/4						9.52 / 3/8
		GAS	mm/in	9.52 / 3/8		12.7 / 1/2	15.88 / 5/8			
REFRIGERANT TYPE & CONTROL				R22 / CAPILLARY TUBE (OUTDOOR)						

- All specifications are subjected to change by the manufacturer without prior notice.
- All units are being tested and comply to ARI 210 / 240.
- YWM 10G is ordered based on project basis only.

Appendix 2 : Daikin Table (Must be return with answer booklet)

									Date :		
Company :						Name of person					
Address:						in charge					
Name of room						Room area (W)					m^2
Floor :						Room Volume :(Area)					m^3
Items				A		Cooling					
						coef B	C = A x B	coef.f		Load Q = f X C	
Wall faced to the outdoor					m^2			1			
					m^2						
					m^2						
					m^2						
					m^2						
Roof					m^2						
Window glass					m^2			Coefficient of Heat			
					m^2						
					m^2						
					m^2						
Partition			AREA		m^2			1			
					m^2						
					m^2						
Ceiling					m^2						
Floor					m^2						
Outdoor air	Invasion of outdoor air		Room Vol.		m^3			Area corr.1.0			
Heat generation in the room	Person		Number					1			
	Light	Electric light			kw	860		Rate of using	1		
		Fluorescant light			kw	1000			1		
	Electric apparatus				kw	860			1		
					kw	860			1		
	SH	equipment			m^3/h						
		person			m^3/h						
btu/h = kcal/hr x 3,97			Total cooling load (kcal/hr)								
										0,7	
			Total cooling load in btu/hr								

Appendix 3 : Formula:

- *1ft = 12inch*
- *1 m = 3.28 ft*
- *1 hr = 15°*
- *1° = 60'*
- *R = 1/c or $\Delta x/k$ where Δx = thickness*
- *U = 1/R or 1/ $\sum R$*
- *Q = UA ΔT*
- *$t_{sol} = t_{std} - (L_{std} - L_{loc})$ 4min/° + E_t*
- *H = t_{sol} - 12: 00*
- *sin β = cos l cos h cos d + sin l sin d*
- *cos ϕ =(sin β sin l – sin d) / (cos β cos l)*
- *$\gamma = \phi \pm \psi$*
- *cos θ = cos β cos γ sin α + sin β cos α*
- *$G_{ND} = A/e^{(B/\sin \beta)}$*
- *$G_D = G_{ND} \cos\theta$*
- *$G_R = G_{th} \rho Fwg$*
- *Fwg = (1- cos $\sum$)/ 2, where $\sum = 90 - \alpha$ (α = 0 for horizontal)*
- *Gd = (C)(G_{ND})*
- *Gt = GD + Gd + GR or Gt = GD + Gd*
- *L_{std} = 120°E*
- *Bangi = L_{loc} = 101° 48'E, l = 2° 56'N*
- *Pulau Pinang = L_{loc} = 100° 38'E*
- *Johor Bahru = L_{loc} = 103° 55'E, l = 1° 28'N*
- *Kuching = L_{loc} = 110° 19'E, l = 1° 28'N*
- *Kota Bahru = L_{loc} = 102° 15'E, l = 7° 48'N*
- *Kota Kinabalu = L_{loc} = 116° 05'E, l = 5° 59'N*
- *Malacca = L_{loc} = 102° 18'E*
- *Q wall = U x A x CLTD corr*
- *Q roof = U x A x CLTD corr*
- *CLTD corr = (((CLTD + Lm) x 5/9) x K) + (25.5 °C – Ti)+ (To – 29.4 °C)*
- *Lm = Correction Latitude*
- *K = Correction of color,black = 1,light color = 0.5*
- *Ti = Inside temperature*
- *°F to °K = multiply by 5/9*
- *English to S.I unit (U value) = multiply by 5.678 ($W/m^2.K$)/($Btu/hr.ft^2.F$)*
- *To = Outdoor Temperature – (RH x Temperature Range)*
- *Q cond = U x A x CLTDcorr*
- *CLTDcorr = (CLTD x 5/9) + (25.5 °C – Ti)+ (To – 29.4 °C)*
- *Q sol = A x SC x SHGF x CLF*
- *Qapp = A x q appl x CLF*
- *Q light = A x q light x CLF*
- *Q occ = No.of Occupants x q occ x CLF*